

Claims

What is claimed is:

- 1           1.       A method for determining the angular orientation of an object  
2       comprising:  
3               obtaining a plurality of images of the object;  
4               assigning values to a plurality of positions in a polar plot using data  
5       from the images wherein the polar plot has an origin; and  
6               computing a centroid based on the assigned values wherein an angle of  
7       the centroid with respect to the origin indicates the angular orientation of the  
8       object.
- 1           2.       The method according to claim 1, wherein said assigning comprises  
2       identifying positions in the polar plot that are uniformly spaced, identifying  
3       corresponding pixels in the image for the positions in the polar plot and  
4       assigning luminance values for the pixels to the positions in the polar plot.
- 1           3.       The method according to claim 2, wherein said assigning further  
2       comprises interpolating for positions in the polar plot that are between pixels.
- 1           4.       The method according to claim 1, wherein said assigning results in a  
2       non-linear mapping of pixel position to polar position.
- 1           5.       The method according to claim 1, further comprising determining a  
2       width of the object by scanning each image.
- 1           6.       The method according to claim 1, further comprising calibrating  
2       cameras prior to obtaining the images from the cameras.
- 1           7.       The method according to claim 6, wherein said calibrating comprises  
2       obtaining images of a cylindrical object of uniform color.

1        8.        The method according to claim 1, wherein the plurality of images  
2 consists of four images taken by each of four cameras and wherein said  
3 assigning includes assigning one of the images to each of four quadrants of the  
4 polar plot.

1        9.        The method according to claim 1, wherein the plurality of images  
2 consists of three images taken by each of three cameras and wherein said  
3 assigning includes assigning one of the images to each of three 120 degree  
4 intervals of the polar plot.

1        10.       The method according to claim 1, the polar plot is divided into sectors  
2 with an image of the plurality being obtained for each sector and with all  
3 sectors of the polar plot being imaged.

1        11.       The method according to claim 1, wherein said images are obtained  
2 from near-infrared light from the object.

1        12.       The method according to claim 1, further comprising determining a  
2 location of the object in the field of view of each of a plurality of cameras and  
3 when the object is not in the center of the field of view, said assigning is  
4 corrected according to its distance from the center.

1        13.       The method according to claim 1, wherein the object is a person's  
2 head.

1        14.       The method according to claim 13, further comprising directing the  
2 person's voice at a remote location according to the angular orientation of the  
3 person's head.

1        15.       The method according to claim 13, further comprising estimating a  
2 vertical position of the person's eyes and obtaining luminance values of the  
3 images at or below the level of the person's eyes.

1        16.    The method according to claim 15, wherein said estimating comprises  
2        scanning the images to locate the top of the person's head and measuring a  
3        distance down from the top of the person's head.

1        17.    The method according to claim 15, wherein said estimating comprises  
2        scaling the images.

1        18.    The method according to claim 13, further comprising performing a  
2        180 degree correction of angular orientation of the person's head.

1        19.    The method according to claim 13, further comprising displaying  
2        images of a remote location for the person.

1        20.    The method according to claim 13, wherein said images are formed by  
2        performing difference keying.

1        21.    The method according to claim 20, wherein said images are obtained  
2        from near-infrared light from the person's head.

1        22.    The method according to claim 20, wherein said performing difference  
2        keying includes subtracting a baseline image of an apparatus from an image  
3        obtained with the person's head being located within the apparatus.

1        23.    The method according to claim 22, wherein the apparatus comprises  
2        projection screens that substantially surround the person.

1        24.    The method according to claim 1, wherein the luminance values  
2        assigned to the polar plot are obtained from a band around the object that is  
3        one pixel wide.

1        25.    The method according to claim 1, wherein the values assigned to the  
2        polar plot are luminance values obtained from a band around the object that is  
3        multiple pixels wide.

1        26.     The method according to claim 25, wherein the luminance values  
2        assigned to the polar plot represent a vertical average.

1        27.     The method according to claim 25, wherein said assigning further  
2        comprises performing bi-linear interpolation for positions in the polar plot that  
3        are between pixels.

1        28.     The method according to claim 1, wherein the values assigned to the  
2        polar plot represent vertical luminance variance.

1        29.     The method according to claim 1, wherein the values assigned to the  
2        polar plot represent vertical frequency content.

1        30.     A program storage device readable by a machine, tangibly embodying  
2        a program of instructions executable by the machine to perform method steps  
3        for determining the angular orientation of an object, said method steps  
4        including obtaining a plurality of images of the object, assigning values to a  
5        plurality of positions in a polar plot using data from the images wherein the  
6        polar plot has an origin, and computing a centroid based on the assigned  
7        values wherein an angle of the centroid with respect to the origin indicates the  
8        angular orientation of the object.

1        31.     A system for determining the angular orientation of an object  
2        comprising:  
3                a plurality of cameras for obtaining a plurality of images of the object;  
4        and  
5                a computer for assigning values to a plurality of positions in a polar  
6        plot using data from the images wherein the polar plot has an origin and the  
7        computer for computing a centroid based on the assigned values wherein an  
8        angle of the centroid with respect to the origin indicates the angular orientation  
9        of the object.